NORTH CAROLINA DIVISION OF AIR QUALITY

Air Permit Review

Permit Issue Date:

Region: Washington Regional Office
County: Bertie
NC Facility ID: 0800044
Inspector's Name: Betsy Huddleston
Date of Last Inspection: 01/15/2015
Compliance Code: 3 / Compliance - inspection

Facility Data

Applicant (Facility's Name): Avoca Incorporated

Facility Address:
Avoca Incorporated
841 Avoca Farm Road
Merry Hill, NC 27957

SIC: 2087 / Flavoring Extracts And Syrups,nec
NAICS: 31193 / Flavoring Syrup and Concentrate Manufacturing

Facility Classification: Before: Title V **After:** Title V
Fee Classification: Before: Title V **After:** Title V

Permit Applicability (this application only)

SIP: 2D .0530, 2D .0535, 2D .0958, 2D .1806
NSPS: N/A
NESHAP: N/A
PSD: BACT limit for VOC only
PSD Avoidance: N/A
NC Toxics: N/A
112(r): N/A
Other: N/A

Contact Data

Facility Contact	Authorized Contact	Technical Contact
Brian Conner Environmental Health & Safety Manager (252) 482-2133 PO Box 129 Merry Hill, NC 27957	David Peele Owner / President (252) 482-2133 PO Box 129 Merry Hill, NC 27957	Samuel Tynch Director of Operations/Engineering (252) 482-2133 PO Box 129 Merry Hill, NC 27957

Application Data

Application Number: 0800044.15A
Date Received: 09/04/2015
Application Type: Modification
Application Schedule: PSD

Existing Permit Data

Existing Permit Number: 01819/T44
Existing Permit Issue Date: 03/10/2015
Existing Permit Expiration Date: 07/31/2015

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2013	11.85	27.84	1055.94	18.70	0.4600	250.74	155.43 [Methanol (methyl alcohol)]
2012	13.64	24.08	931.29	43.64	0.4430	214.72	145.25 [Methanol (methyl alcohol)]
2011	17.06	13.79	491.30	2.79	0.6600	123.95	68.53 [Methanol (methyl alcohol)]
2010	13.60	9.07	231.31	1.90	0.4200	67.49	52.54 [Hexane, n-]
2009	16.94	11.33	309.15	2.37	0.5200	49.16	26.74 [Hexane, n-]

Review Engineer: Betty Gatano

Review Engineer's Signature: **Date:**

Comments / Recommendations:
Issue 01819/T45
Permit Issue Date:
Permit Expiration Date:

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1.0 Introduction and Purpose of Application

1.1 Facility Description & Proposed Change

Avoca Incorporated (Avoca) currently holds Title V Permit No. 01819T44 with an expiration date of July 31, 2015 for a chemical extraction facility in Merry Hill, Bertie County, North Carolina. The facility extracts oils and nutrients from various types of plants for use in flavorants, fragrances, food additives, and dietary supplements. The main product at the facility is sclareol/sclareolide. Sclareol is extracted from clary sage grown on farms surrounding the Avoca facility. The extracted material is converted to sclareolide offsite and purified at the Merry Hill facility. Sclareolide is the final product and is used to maintain fragrance potency in perfumes, laundry detergents, and a variety of other products.

There are four processes involved in producing sclareolide – Rotocel, Recovery, Sclareol Recrystallization Operations (SFG), and Sclareolide Operations (SDE).

In the first process, clary sage is augured to a belt that carries it to an extractor called the Rotocel. Hexane isomer is added to the extractor to strip out sclareol from the sage. Spent sage from the Rotocel is sent to a desolventizer, which drains the hexane from the sage. Volatilized hexane is condensed and collected in the solvent separation/recovery tank. Condensed water and hexane separate in this tank (hexane floats), and the recovered hexane is stored in two recycle process tanks. The sage exiting the desolventizer is hot and contains a significant amount of hexane. Most of the hexane flashes fugitively to the atmosphere when the sage is removed from the desolventizer.

The sclareol/hexane material leaving the Rotocel process is sent to the Recovery process. In this step, hexane from the sclareol/hexane mixture is flashed off in the stripper, and the sclareol is mixed in a receiving tank with methanol to further strip out hexane. The resulting purified oil settles to the bottom of the tank and is drawn into buckets. The Recovery process can produce up to 100 cans sclareol oil/day (47 lbs/can), but Avoca is currently producing approximately 85 cans/day.

The sclareol buckets are carried to the SFG (sclareol recrystallization) process, where the sclareol oil is crystallized into a white powder. The SFG operations consist of a series of tanks, two reactors, a centrifuge, and a dryer. The sclareol and heptane are fed to a reactor, and the crystallized material is sent to a centrifuge and dryer. Heptane recovered from the first pass is sent to a second reactor to recover any additional sclareol. As before, the crystallized material is sent to the centrifuge and dryer. The sclareol comes out of the dryer as a white powder. Heptane recovered from the second reactor is again reprocessed to recover any remaining heptane. The residual material remaining after the final heptane recovery is a waste by-product.

The powder is bagged and shipped to an Avoca plant in Wisconsin, where the material is converted from sclareol to sclareolide by yeast (i.e., biological conversion). The sclareolide returns to the Merry Hill facility as a white powder, which is purified in the Sclareolide Operations (SDE). The powder is placed in a tank with water and iso-hexane (40% n-hexane). The mixture is processed through reactors, a centrifuge, and a dryer. The final, purified sclareolide remains a white powder.

<u>PSD Project</u>
A permit application for a modification under 15A NCAC 2D .0530, “Prevention of Significant Deterioration” (PSD), was received on September 4, 2015. Avoca is proposing to expand the SFG operations. The capacity of the SFG operations will be tripled under the proposed project. The following equipment will be added to the facility under the SFG expansion:

- One 12,500 gallon storage tank (ID No. T-3006)
- One 12,500 gallon process tank (ID No. T-3007)
- Two reactors (ID Nos. R-3003 and R-3004) with process condensers (ID Nos. EX-3004 and ES-3005)
- One centrifuge (ID No. C-3002)
- One dryer with (ID No. D-3002) with process condenser (ID No. ES-3006) and a chilled water control condenser (ID No. CD-3002)
- Optional controls – chilled water control condenser (ID No. CD-3003) and mineral oil scrubber (ID No. CD-3004-S).

The optional condenser and mineral oil-scrubber are to be installed on the vents from all (new and existing) storage tanks, reactors, centrifuges, and dryers in the SFG operations. The intent of adding these control devices is to recover as much heptane as possible for reuse in the operations. As optional control devices, their removal efficiencies are not considered when calculating emissions from the SFG operations.

The proposed project will increase VOC emissions by more than the PSD significant emission rate (SER) of 40 tons per year. Thus, the proposed project is subject to review and processing under 15A NCAC 2D .0530, PSD. The facility must also comply with other specific NCDAQ air pollution regulations where applicable.

In accordance with PSD requirements, Avoca has conducted a Best Available Control Technology (BACT) analysis, additional impacts (soils, vegetation, visibility) analysis, and to the extent necessary, Class I area analysis.

Avoca also submitted an application for a permit renewal on October 31, 2014, or at least nine months prior to the expiration date of July 31, 2015. Therefore, the application shield as specified under 15A NCAC 2Q .0512(b) remains in effect. Because the renewed permit has not yet been issued, the expiration date will be changed to [REVISED DATE] under this permit modification. A footnote also will be added to the permit stating, "This permit shall expire on the earlier of [REVISED DATE] or the date the renewal of Air Permit No. 01819T44 has been issued or denied."

1.2 Plant Location

Avoca is located at 841 Avoca Farm Road, Merry Hill, North Carolina, which is in eastern Bertie County. Bertie County has been classified as in attainment for all pollutants subject to a National Ambient Air Quality Standard (NAAQS).

1.3 Permitting History Since Issuance of Title V Permit Renewal

Permit	Issue Date	Description
01819T37	August 17, 2010	TV permit renewal issued with an expiration date of July 31, 2015.
01819T38	June 3, 2011	Air permit processed as significant modification under a 15A NCAC 2Q .0501(c)(2) for the addition of the following: • two new biomass/bio-based solids-fired boilers (18.6 million Btu per hour maximum heat input, ID Nos. ES-BB1 and ES-BB2) controlled by a cyclone (144 inches in diameter, ID No. CD-BB1C) in series with a dry lime injected bagfilter

Permit	Issue Date	Description
		(8,900 square feet of filter area, ID No. CD-BB1BH), and • one No. 2 fuel oil-fired rotary dryer (6.0 million Btu per hour maximum heat input, ID No. ES-RD).
--	--	"Part 2" permit application for the new biomass/bio-based solids-fired boilers (ID Nos. ES-BB1 and ES-BB2) received on October 9, 2012. The permit application will be consolidated with the application for TV permit renewal.
01819T39	January 4, 2013	The air permit was reopened for cause to correct specific condition (2.1 E.7.) pertaining to MACT Subpart DDDDD for two biomass boilers (ID Nos. ES-BB1 and BB2). The condition contained an incorrect compliance date and was corrected under the permit modification.
01819T40	June 6, 2013	Air permit processed as significant modification under a 15A NCAC 2Q .0501(c)(2) to modify the SFG operations by replacing the current dryer with a new larger capacity dryer (ID No. D-3001). A new larger reactor (ID No. R-3002) equipped with a process condenser (ID No. EX-3003) was also added under this modification. The smaller reactor (ID No. R-3001) was to be used as a secondary reactor after modification.
01819T41	November 26, 2013	Air permit processed as significant modification under a 15A NCAC 2Q .0501(c)(2). The following changes were made under the permit modification. • Updated CO and NOx emission factors for the biomass boilers (ID Nos. ES-BB1 and BB2). Stack testing performed on December 6, 2011 while firing wood showed measured emission factors of 0.068 lb/MMBtu for NOx and 0.0008 lb/MMBtu for CO. • Replaced the existing six MMBtu/hr burner on the rotary dryer with a 30 MMBtu/hr burner and added propane as a fuel. • Updated the maximum burner rating of the two (2) biomass boilers. The boilers heat input rating was increased from the permitted 18.6 MMBtu/hour each to a maximum heat input to 24 MMBtu/hour each. • Limited VOC emissions from the rotary dryer to less than 40 tpy to avoid triggering PSD requirements. • Limited n-hexane from the rotary dryer to less than 10 tons per year to avoid being subject to the 112(g) requirements listed in 15A NCAC 2D .1112. • Clarified the operating configuration of the sage drying system.

Permit	Issue Date	Description
01819T42	January 27, 2014	Air permit processed as a minor modification with the following changes: • Replaced two underground storage tanks (ID No. ES-1001-2-1-P2) with two above ground storage tanks (20,000 gallons capacity each, ID Nos. ES-M-125A and 125B). • Added a new storage tank associated with the Plant Nutrient Extraction (PNE) operations (9,500 gallons capacity, ID No. ES-TK-PNE-1). • Added a sage briquette making machine (ID No. I-Briquette) with enclosed conveyors. • Added a molecular sieve (ID No. MSDU-1024) as part of the description for the Biomass Extraction operations (which was added to Air Permit No. 01819T41). • Included existing diesel emergency generator (401 horsepower, ID No. E104) to the permit.
--	--	"Part 2" permit application for changes to the SFG operations and modifications to boilers (ID Nos. ES-BB1 and BB2) and rotary dryer (ID No. ES-RD) received on May 30, 2014. The permit application will be consolidated with the application for TV permit renewal.
--	--	Permit application for renewal of the Title V permit was received on October 31, 2014.
01819T43	December 19, 2014	Air permit processed as a minor modification with the following changes: • Updated capacity of above ground storage tanks (ID Nos. ES-M-125A and 125B) to 19,500 gallons. • Added a condenser (ID No. CD-3002) to the existing dryer (ID No. D-3001) in the SFG operations.
01819T44	March 10, 2015	Air permit processed as significant modification under a 15A NCAC 2Q .0501(c)(2), which was consolidated with a minor modification. The following changes were made under the permit modification. • Added a new dryer equipped with chilled water condenser and distillate tank (ID No. D-1002) after the centrifuge (ID No. C-1203) in the PNE operations. • Removed a underground ethanol storage process tank from the PNE operations (ID No. TK-9214). • Modified conditions to indicate the scrubbers are not required to operate during PNE and EVG operations. • Re-evaluated the operating temperature limit for the cryogenic condensers in the Botanical/Biomass Extraction Operations.

1.4 Application Chronology

Date	Event
August 21, 2015	Pre-application meeting between NCDAQ and Avoca occurred.
August 25, 2015	Tom Anderson of the Air Quality Analysis Branch of NCDAQ e-mailed personnel from US Forest Service, the Fish and Wildlife Services, and the National Park Service informing them of the project and the potential VOC emissions expected.
August 25, 2015	Melanie Pitrolo of the US Forestry Service sent an e-mail to Tom Anderson indicating that no additional information was needed for this project.
August 26, 2015	Jill Webster of the Fish and Wildlife Service sent an e-mail to Tom Anderson indicating that no additional information was needed for this project.
September 4, 2015	PSD permit application received.
September 9, 2015	A permit application acknowledgment letter was issued.
September 16, 2015	Betty Gatano issued a letter to Avoca indicating that the PSD application was deemed complete.
October 20, 2015	Draft permit and permit review sent for internal review.
October 28, 2015	Mark Cuilla provided comments on the draft permit and permit review.
October 30, 2015	Draft permit and permit review sent to Dana Norvell, consultant for the facility.
November 9, 2015	Dana Norvell provided comments on the draft permit and permit review.
November24, 2015	Draft permit and permit review sent to public notice.

2.0 Modified Emission Sources and Emissions Estimates

The SFG operations are an intermittent batch process for producing a refined high purity sclareol. In the SFG operations, sclareol oil from the Recovery process is mixed with high purity heptane, centrifuged, and dried to higher purity powder for further processing offsite. Heptane is used in the SFG operations to dissolve the sclareol, and ethyl acetate is added to control the rate of crystallization. The SFG operations are composed of the following four steps:

- Virgin solvent tank fills
- Treater batch
- Recrop batch, and
- Third crop batch.

The primary batch or treater batch is the initial processing step, where sclareol is extracted (dissolved) with heptane, centrifuged, and dried. The recovered heptane from the treater batch is called "Mother liquor" and is reprocessed in the recrop batch to extract any remaining sclareol. As before, the sclareol is centrifuged and dried as product. Heptane recovered from the recrop batch is again reprocessed in the third crop batch. This final step is intended to recover heptane only and not to obtain product. The residual material remaining after heptane recovery is a sludge. It is not dried and is considered a waste by-product.

The expanded SFG operations will use a series of storage tanks, four reactors, two centrifuges, and two dryers to recrystallize the sclareol into powdered form. The specific equipment in the SFG operations after modification are the following:

- One process tank (6,700 gallon capacity) (ID No. T-3001)
- Four process tanks (2,500 gallons capacity each) (ID Nos. T-3002 through T-3005)

- Reactor No. 1equipped with two chilled water process condensers (EX-3001 and EX-3002) (ID No. R-3001) with control chilled water condenser (ID No. CD-3001)
- Reactor No. 2 equipped with a chilled water process condenser (EX-3003) (ID No. R-3002)
- Centrifuge (ID No. C-3001)
- Steam-heated dryer equipped with a chilled water process condenser (EX-3002) (ID No. D-3001) with control chilled water condenser (ID No. CD-3001)
- One storage tank (12,500 gallons) (ID No. T-3006)
- One process tank (12,500 gallons) (ID No. T-3007)
- Reactor No. 3 equipped with a chilled water process condenser (EX-3004) (ID No. R-3001)
- Reactor No. 4 equipped with a chilled water process condenser (EX-3005) (ID No. R-3002)
- Centrifuge (ID No. C-3002)
- Steam-heated dryer equipped with a chilled water process condenser (EX-3006) (ID No. D-3002) with control chilled water condenser (ID No. CD-3002).

All these emission sources may be controlled with optional control devices consisting of a chilled water condenser (ID No. CD-3003) in series with a mineral oil scrubber (ID No. CD-3004-S).

Avoca tracks the usage of heptane and ethyl acetate and reports solvent used as solvent lost to determine monthly emissions (i.e., a mass balance based on usage). The facility determined the maximum actual usage data and prorated this amount to the maximum potential operations to determine potential VOC emissions from the expanded process.

The maximum VOC usage occurred in March 2015 and was 5.31 tons of VOC per month. This value was increased by a factor of 3.41 to account for maximum production in the expanded operation. The increased factor was estimated by dividing the desired production after modification by the current production. In other words, the desired production after modification was shown to be 3.41 times the maximum production levels. Finally, the resulting value was multiplied by 12 months to arrive at potential VOC emissions after expansion. The potential VOC emissions are calculated as shown in the following equation:

Potential VOC emissions = 5.31 tons/month * 3.41 * 12 months/year = 217.4 tons VOC/year

The maximum usage of VOC reported in March 2015 is less than historic monthly VOC usage in the SFG operations. Prior to November 2014, Avoca used n-hexane and hexane isomers in the SFG operations rather than the heptane that is currently being used. When Avoca began using heptane as a solvent in the SFG operations, the VOC usage (and resultant emissions) was substantially less as compared to hexane loss. Thus, basing the VOC emissions on the previous hexane emissions would not be reflective of the current operations at the facility.

This potential emission estimate of 217.4 tons per year represents the total amount of VOC lost from the SFG operations and accounts for both losses through point sources and fugitive emission sources. The point sources are the process vents associated with the equipment in the SFG operations. Fugitive emissions are those emissions that cannot reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Thus, fugitive emissions include not only emissions from equipment leaks (pumps, flanges, valves etc.) but emissions from other areas throughout the SFG operations that are not vented through a stack. The latter category includes but is not limited to the following sources of fugitive emissions:

- Emissions are lost when reactor R-3002 is opened for charging the wax (sclareol) and heptane into the reactor (prep step).

- A pot is ahead of the vacuum pump that drains into a 55 gallon drum. This stream contains heptane and is a possible fugitive emission source.
- An insoluble layer is formed in the reactor vessel after the water wash. Avoca drains off the top layer into a trench drain inside the process building. This layer will contain some heptane in the liquid form. Although this water is sent to the wastewater treatment plant (WWTP), the majority of the heptane in the stream evaporates prior to reaching the WWTP, thus creating a fugitive emissions area source.
- The centrifuge is equipped with a "knife" to scrape the material from the sides of the vessel however it is not able to reach all of the material. Avoca must open the centrifuge on a regular basis to manually scrape the vessel. Some heptane could be released during the opening of the centrifuge.
- Avoca samples the batch during the crystallization step by draining the material into a 5 gallon pail and then returns the material to the vessel. Some VOC's will be emitted from this pail during sampling because it is opened to the atmosphere.

Potential emissions lost from process vents (points sources) were calculated from emission equations and methodology in "NESHAP for Pharmaceuticals Production," 40 CFR Part 63, Subpart GGG (40 CFR 63.1257). As shown in the detailed calculations in Appendix B of the permit application, emissions from the process vents were estimated as 14.7 tons per year. VOC emissions not lost through vents were assumed to be lost via fugitives as calculated from a material balance. Based on the material balance, approximately 93% of the VOC are assumed to be lost via fugitive emission sources and 7% are lost via process vents. The table below provides a summary of the VOC emissions.

Emissions Source	**Amount**	**Basis for emissions**
Total VOC emissions from expanded SFG Operations	217.4 tons per year	Based on maximum monthly VOC usage rate and scaled up to account for expansion
VOC Emissions from Process Vents	14.7 tons per year	Equations / methodology in 40 CFR 63.1257 and shown in Appendix B of the permit application. Emissions were estimated assuming no control of the VOC.
VOC emissions from fugitives	202.7 tons per year	Total VOC emissions – VOC emissions from process vents

3.0 Project Regulatory Review

The modified SFG operations will be subject to the following regulations.

- <u>15A NCAC 2D .0530, Prevention of Significant Deterioration</u> – Because the plant is located in Bertie County, an attainment area for all NAAQS, the planned modification and its emissions are required to be assessed in light of PSD requirements. Avoca is a major stationary source for PSD purposes, and the emission increases as a result of this modification exceed the significance levels as listed in 40 CFR 51.166 (23)(i). As discussed in greater detail in Section 4, the BACT limit for the SFG operation is 217.4 tons per year (tpy) of VOC (12-month running total).

- <u>15A NCAC 2D .0535, Excess Emissions Reporting and Malfunctions</u> – This regulation applies to all permitted facilities and outlines the procedures of reporting excess emissions as a result of malfunctions or operational upsets. The facility owner/operator must notify the appropriate regional office of any excess emissions that are the result of a malfunction or upset condition and that last for greater than four hours. This report must be made within 24 hours of becoming aware of the occurrence.

- 15A NCAC 2D .0958, Work Practices for Sources of Volatile Organic Compounds – This regulation establishes work practice standards for sources that emit VOC. Because VOC are being used as a material processing media, the regulation is applicable to this facility.

- 15A NCAC 2D .1806, Control and Prohibition of Odorous Emissions – This rule is state enforceable only and is applicable facility-wide. Under this regulation, no facility shall operate without employing suitable measures for the control of odorous emissions. There is no history of odor complaints from the existing operations.

Based on the potential emissions from this project, the additional equipment added for the expansion of the SFG operations will be subject to Title V permitting. Avoca has requested that this application be processed pursuant to 15A NCAC 2Q .0501(d)(1) and the PSD rules (15A NCAC 2D .0530).

As noted above, Avoca used a blend of n-hexane (95%) and hexane isomers (5%) in the SFG operations until November 2014. The compound n-hexane is a hazardous air pollutant (HAP), which made the SFG operations subject to as the "NESHAP for Miscellaneous Organic Chemical Manufacturing," 40 CFR 63 Subpart FFFF, also referred to the "Miscellaneous Organic NESHAP" or MON.

Per 40 CFR 63.2435(a), a facility is subject to the MON if it owns or operates miscellaneous organic chemical manufacturing process units (MCPU) that are located at a major source of HAPs. Further, a MCPU includes all equipment necessary to operate a miscellaneous organic chemical manufacturing process that satisfies *all* of the conditions specified in 40 CFR 63.2435(b)(1) through (3). Avoca will only use heptane and ethyl acetate, neither of which are HAPs, in the SFG operations after modification. With this change, the SFG operations no longer meet condition 40 CFR 63.2435(b)(2), which requires that a MCPU processes, uses, or generates an organic HAP. Thus, the SFG operations will not be subject to the MON after this modification, because it no longer processes, uses, or generates an organic HAP.

4.0 Prevention of Significant Deterioration

The basic goal of the PSD regulations is to ensure that the air quality in clean (i.e. attainment) areas does not significantly deteriorate while maintaining a margin for future industrial growth. The PSD regulations focus on industrial facilities, both new and modified, that create large increases in the emission of certain pollutants. The EPA promulgated final regulations governing the PSD in the Federal Register published August 7, 1980. Effective March 25, 1982, the NCDAQ received full authority from the EPA to implement PSD regulations in the state.

4.1 PSD Applicability

Under PSD requirements all major new or modified stationary sources of air pollutants regulated and listed in this section of the Clean Air Act must be reviewed and approved prior to construction by the permitting authority. A major stationary source is defined as any one of 28 named source categories that has the potential to emit 100 tons per year of any regulated pollutant or any other stationary source that has the potential to emit 250 tons per year of any PSD regulated pollutant. Avoca is a chemical processing plant, which is one of the 28 listed source categories with major source thresholds of 100 tons per consecutive 12-month period, under 40 CFR 51.166 (b)(1)(i)(a). It is a major stationary source for PSD purposes, therefore the emission increases as a result of this modification must be compared to the significance levels as listed in 40 CFR 51.166 (23)(i) to determine which pollutants must undergo a PSD review.

For this proposed modification, emissions of VOC exceed the significance level of 40 tons per year. Other PSD regulated pollutants are not emitted as part of this modification. Thus, Avoca performed the following reviews and analysis related to PSD for VOC for this modification:

- A BACT determination, and
- An additional impacts analysis including effects on soils, vegetation, and visibility.

4.2 BACT Analysis

Under PSD regulations, the determination of the necessary emission control equipment is developed through a BACT review. BACT is defined, in pertinent part, by the Federal Register [40 CFR 51.166 (b)(12)] as:

> *An emissions limitation... based on the maximum degree of reduction for each pollutant... which would be emitted from any proposed major stationary source or major modification which the reviewing authority, on a case-by-case basis, taking into account energy, environment, and economic impacts and other costs, determines is achievable... for control of such a pollutant.*

The BACT requirements are intended to ensure that the control systems incorporated in the design of the proposed facility reflect the latest control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the facility. Additionally, the BACT analysis may consider the impacts of non-criteria pollutants and unregulated toxic air pollutants, if any are emitted, when making the BACT decision for regulated pollutants. The pollutant subject to PSD review for the expanded SFG operations at Avoca is VOC.

Each pollutant subject to a PSD review must meet the criteria of BACT, which refers to the maximum amount of emission reduction currently possible with respect to technical application and economic, energy, and environmental considerations. Because equipment within categories of sources vary widely, it is difficult to establish a uniform BACT determination for a particular pollutant or source. Economics, energy, and environment in combination with the unique functions of the source and engineering design, require BACT to be determined on a case-by-case basis. In most instances BACT may be defined through an emission limitation. In cases where this is impossible, BACT can be defined by the use of a particular type of control device and its achievable emission reduction efficiency. In no event can a technology be recommended that would not comply with any applicable standard of performance under 40 CFR Part 60 and 61.

The BACT analysis performed for Avoca included five basic steps listed below:

1) Identify all control technologies,
2) Eliminate technically infeasible options,
3) Rank remaining control technologies by control efficiencies,
4) Evaluate the most effective controls and document results, and
5) Select BACT.

The first step in this approach is a comprehensive listing of control technologies for each applicable pollutant. Step two is a demonstration of technical feasibility to ensure the technology evaluated was appropriate for the characteristic gas stream to be treated. Step three ranks the remaining control technologies by control effectiveness, including the control efficiencies (percent of pollutant removed), expected emission rate (tons per year and pounds per hour), expected emission reduction (tons per year), economic impacts (cost effectiveness), environmental impacts (including emission of toxic or hazardous air contaminants), and energy impacts (benefits or disadvantages). Step four is a case-by-case evaluation of energy, environmental, and economic impacts. Step five requires the selection of BACT for the emission source. While the steps are similar to EPA's top-down process, unlike the EPA decision process, NCDAQ follows statutory mandate that economics, energy, and environmental impacts of candidate technologies be evaluated.

4.3. BACT Analysis for SFG Process Vents

4.3.1 Identify Control Technologies

An investigation was performed to identify current regulatory BACT/LAER determinations for extraction operations. Because SFG operations are unique, the search focused on proven control technologies for other extraction operations, which are mostly associated with vegetable oil extraction, such as soybeans. The search involved a review of EPA's RACT/BACT/LAER clearinghouse (RBLC), which included information on BACT and LAER decisions throughout the country.

The review of NSR permit data in the RBLC identified 59 decisions involving facilities with emission sources comparable to the proposed sources. The primary types of controls identified as BACT in the RBLC search were mineral oil scrubbers, alone or with condensers (13); scrubbers or absorption, but not specifically mineral oil scrubbers, alone or with condensers (14); and emission limits (9). A carbon adsorption was identified as control in one draft decision in the RBLC results. Five decisions cited leak detection and repair (LDAR) as BACT for process leaks. Also, note that not all these controls were installed as a result of BACT or LAER requirements. The results of the RBLC search were provided in an e-mail dated September 16, 2015 to Betty Gatano of the NCDAQ.

Based on an extensive search of RBLC results, as well as a review of relevant literature and knowledge of controls for similar industries, the following control technologies were considered in this BACT analysis:

- Thermal Oxidation Systems
- Catalytic Oxidation Systems
- Adsorption Systems
- Absorption Systems
- Biofiltration Systems
- Condensation Systems.

4.3.2 Eliminate Technically Infeasible Options

<u>Catalytic Oxidation/Thermal Catalytic Oxidation</u>
In a catalytic oxidizer, a catalyst is used to lower the activation energy needed for oxidation. When a preheated gas stream is passed through a catalytic oxidizer, the catalyst bed initiates and promotes the oxidation of VOC without being permanently altered. In catalytic oxidization, combustion occurs

at significantly lower temperatures than with thermal oxidization. However, care must be taken to ensure complete combustion.

A major disadvantage of catalytic oxidization is the high cost of fuel and catalyst replacement. Although catalytic oxidization requires less fuel than thermal oxidization at the same heat recovery rate, the catalyst replacement costs can be significant. In some cases, disposal of spent catalyst can also prove a difficult hurdle because of deposits of potentially hazardous substances.

Catalytic oxidation is not considered to be technically feasible in this situation. Oxidation is a potential source of ignition and explosion hazard, which is not appropriate when a facility uses a high quantity of explosive material, such as heptane. In addition, the SFG operations may contain chemical compounds that could poison the catalyst. A review of the RBLC search confirmed no extraction processes with this control technology.

Carbon Adsorption

Adsorption is a process where VOCs are removed from low to medium concentration gas streams. The gas molecules pass through a bed of solid particles such as activated carbon, which is the most widely used adsorbent. The molecules are held to the adsorbent by attractive forces that are weaker than chemical bonds.

One draft decision in the RBLC identified carbon adsorption as control on an extraction process. As shown in the results of the RBLC search, the extraction industry primarily uses condensers and mineral oil scrubbers as BACT. Carbon adsorption has been eliminated as a technology has not been demonstrated in practice in the biological extraction industry.

Bio-oxidation / Biofiltration

Bio-filtration is an air pollution control technology in which VOCs are oxidized using living micro-organisms on a media bed (sometimes referred to as a bioreactor). As emissions flow through the bed media, pollutants are absorbed by moisture on the media and come into contact with the microbes. The microbes consume and metabolize the excess organic pollutants, converting them to carbon dioxide and water, much like a traditional oxidation process.

The efficacy of bio-oxidation and biofiltration to remove VOC and HAP emissions from the Avoca plant is unknown. A review of the RBLC search confirms no extraction processes using this control technology as BACT. Due to the undemonstrated nature of bio-oxidation/biofiltration in the biologic extraction industry, this technology has been eliminated from further consideration.

4.3.3 Rank Remaining Control Technologies by Effectiveness

The remaining control technologies were ranked from the most stringent to the least stringent, as shown in the table below.

Control Technology	Approximate Control Efficiency (%)
Regenerative Thermal Oxidation (RTO) + Condenser	98%
Mineral Oil Scrubber (Packed bed absorption) + condenser	98%
Condenser	65%

Thermal Oxidation (Regenerative)
In regenerative oxidation, the inlet gas stream is drawn through a hot ceramic or stoneware bed that preheats the gas stream prior to its entering the combustion chamber. The hot flue gas exits the oxidizer and passes into a second ceramic bed, which captures and stores thermal energy. When this bed has been heated sufficiently, the flow is switched so that the inlet gas is now redirected through the hot bed and the exhaust gas is passed through the now cool primary bed. By switching flows in this manner, high heat exchanger temperatures are maintained. Aside from the ceramic media heat exchanger, regenerative systems operate in the same manner as conventional thermal oxidization.

Regenerative oxidizers provide a high degree of thermal heat recovery and are useful for situations where the air flowrate is high and VOC concentration is low. In these cases, a significant amount of heat recovery is required to minimize overall system operating costs. Costs can be high because of the capital investments, and supplemental fuel along with other operating costs.

Mineral Oil Scrubber (Absorption)
Absorption systems, like the mineral oil scrubber, are used to control gas-phase VOC. The effectiveness of the absorption system will depend on the solubility of the pollutant in the liquid stream, the gas and liquid throughput rates, and the type of scrubber that is selected. The typical scrubber used of this type of operation is a mineral oil scrubber as was confirmed by the search of the RBLC for extraction processes.

Condensers
Condensers operate by separating volatile compounds in a vapor mixture from the remaining vapors by means of saturation followed by a phase change. Condensers are typically refrigerated to decrease the temperature to aid in saturation and therefore increase the removal efficiencies of the units. There are two common types of condensers used for VOC removal – surface and contact condensers. The coolant does not contact the gas stream in surface condensation; the vapor condenses as a film on the cooled surface and then discharges to a collection tank. Conversely, the vapor stream is sprayed with a liquid coolant in a contact condenser. The VOCs contained within the waste coolant often create a disposal problem because they cannot be recycled or separated from the stream without additional processing.

Because the condenser's removal efficiency is highly dependent on the characteristics of the waste gas stream, they are only feasible for removing certain compounds. Compounds with high boiling points and low volatility are more easily condensable than compounds with low boiling points and high volatility. EPA recommends, as a conservative starting point for considering condensers as a control, that the VOCs have boiling points above 100^{o} F. Heptane has a boiling point of approximately 209^{o}F, and condensers are technically feasible as a control option for the SFG operations.

4.3.4 Evaluate Technically Feasible Control Options

A BACT analysis, consistent with the Clean Air Act, was performed on the add-on control technologies that were shown to be technically feasible.

Assumptions Used in the BACT analysis
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO and condenser was estimated as 98%. The removal efficiency of the mineral oil scrubber and condenser and the condenser alone was estimated as 98% and 65%, respectively.

Other assumptions used in performing this analysis are included in the detailed cost calculations presented in Appendix C of the permit application. All cost estimates were prepared using potential VOC emission rates for the expanded SFG operations. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling equipment emissions with add-on controls are presented in the table below. The estimated cost impacts were estimated using the Office of Air Quality Planning and Standards Control Cost Manual (CCM)[1] , past permitting experience, EPA Technology Fact Sheet for packed bed scrubbers, and vender quotes for the condenser. All costs provided in the CCM were updated to 2014 dollars using Consumer Price Index Price Inflation calculator[2].

Add-On Control Technology	**Baseline Emissions (tons/yr)**	**VOC Emissions Reduction (%)**	**VOC Emissions Reduction (tpy)**	**Total Capital Cost (2014 $)**	**Total Annual Cost ($/yr)**	**Cost - Effectiveness ($/Ton)**
RTO and condenser	14.73	98%	14.4	$621,848	$286,134	$19,822
Mineral Oil Scrubber and condenser	14.73	98%	14.4	$4,785	$142,243	$9,854
Condenser only	14.73	65%	9.6	$28,560	$150,631	$15,733
Notes: Avoca would not install a mineral oil scrubber or RTO alone but would install a combination of condenser and mineral oil scrubber or RTO. The cost for the RTO and the mineral oil scrubber do not include the cost of the condenser. Even excluding the condenser, these control devices are not cost effective.						

Energy and Environmental Impacts

Although each of the potentially feasible add-on control devices evaluated would provide reductions in VOC emissions, each device would also have associated negative energy and environmental impacts. The energy and secondary environmental impacts are presented in the table below for each add-on control alternative. In the case of thermal oxidization, the combustion of natural gas would result in small quantities of combustion pollutants: nitrogen oxides (NO_x), sulfur oxides (SO_2), particulate matter (PM), carbon monoxide (CO), and VOCs. Emission factors from EPA's AP-42 document are used to calculate these emissions.

[1] Office of Air Quality Planning and Standards Cost Control Manual. Fourth Edition. EPA-450/3-90-006. Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, North Carolina. January 1990.

[2] Consumer Price Index Calculator developed by the US Department of Labor Bureau of Labor Statistics.

Control Technology	Emissions (tpy)					Energy Impacts
	NOx	SO2	PM	CO	VOC	Electricity Increase over Baseline (MW-hr/yr)
RTO and condenser	0.09	--	0.01	0.07	--	1.13
Mineral Oil Scrubber and condenser	--	--	--	--	--	1.13
Condenser only	--	--	--	--	--	70.1

Notes:
- Natural gas emission factors from EPA's AP-42, Section 1.4 (7/98).
- Natural gas requirements based on vendor specifications.
- Natural gas fuel content assumed to be 1,020 Btu/scfm.

4.3.5 Select BACT for Process Vents

Although add-on controls appear to be technically feasible, after consideration of the environmental, energy, and economic impacts, it was determined that BACT for the process vents do not include these controls.

4.4 VOC BACT Analysis for Process Fugitives

Equipment leaks and other fugitive emissions from the SFG operations are quantifiable based on a material balance of the solvents (heptane and ethyl acetate) used in the process. The emissions occur at various locations or points throughout the SFG operations and the facility indicates that these emissions cannot be easily controlled. The SFG operations are not subject to any Maximum Achievable Control Technology (MACT) standards or New Source Performance Standards (NSPS), and as such, there are no rules applicable to the SFG operations that would require Leak Detection and Repair (LDAR). Thus, Avoca is proposing no work practice standards for this process. Emissions will continued to be calculated via material balance.

4.5 Wastewater

In a 2004 PSD permit application, Avoca proposed BACT to be fixed roof tanks for the process wastewater tanks associated with the Rotocel, Recovery, Biomass Extraction, and Botanical Extraction operations. These same tanks will be used for SFG wastewater. Avoca will continue to comply with the 2004 BACT for wastewater tanks by using fixed roof tanks for all its wastewater operations.

4.6 Overall BACT Limit

Avoca is requesting a BACT limit for the SFG operations of 217.4 tons per 12-month period. The most practical approach for assessing compliance is to continue to conduct a monthly solvent material balance to assess compliance with the BACT limit.

4.7.PSD Air Quality Impact Analysis

PSD regulations [40 CFR 51.166(k)] require an applicant to perform an ambient impact analysis to demonstrate, 1) that no NAAQS will be exceeded at any location and during any time period where the proposed new source or modification will have significant impact; and 2) that the proposed new source or modification, in combination with other increment-affecting sources, will not cause any allowable PSD increment to be exceeded. PSD regulation 40 CFR 51.166(m) requires analysis of ambient air quality in the impact area of the proposed source or modification for all pollutants (including those for which no NAAQS exist) with emissions increases in significant [40 CFR 51.166(b)] quantities.

Potential Emissions

VOC emissions are considered precursors to ozone formation. PSD regulations [40 CFR 51.166(i)] state that an ambient impact analysis of ozone, including the gathering of ambient air quality data, could be required if the net VOC emission increase is greater than 100 tpy. Previous and ongoing regional air dispersion modeling efforts to determine ozone attainment within the North Carolina air shed have shown that VOC emissions at the level stated above will not contribute, by itself, to significant ozone formation. No additional monitoring or modeling is required for this pollutant.

Non-Regulated Pollutant Impact Analysis

Ethyl acetate is a Toxic Air Pollutant (TAP) and the emissions of this TAP will increase after this permit modification. Further, the SFG operations are not subject to a MACT and are not exempt from NC Air Toxics. As required per 15A NCAC 2Q .0706(c), the permit application included an evaluation for ethyl acetate for compliance with NC Air Toxics.

The maximum monthly emissions for ethyl acetate in calendar year in 2014 as reported in the permit application are provided in the following table. As shown below, the facility-wide emissions after modification are less than the toxic permitting emission rate for ethyl acetate. Thus, the modification of the SFG operations poses no unacceptable risk to human health, and no further analysis is needed.

<table>
<tr><th>Operations</th><th>Ethyl Acetate Emissions 2014 (lb/month)</th><th>Ethyl Acetate Emissions after Expansion (lb/month)</th><th>Total Emissions of Ethyl Acetate after Expansion (lb/hr)</th><th>Ethyl Acetate TPER (lb/hr)</th></tr>
<tr><td>Botanical SDA</td><td>48.86</td><td>48.86</td><td rowspan="6">10.4</td><td rowspan="6">36</td></tr>
<tr><td>Botanical</td><td>130.72</td><td>130.72</td></tr>
<tr><td>Biomass</td><td>103.27</td><td>103.27</td></tr>
<tr><td>PNE</td><td>63.73</td><td>63.73</td></tr>
<tr><td>SFG</td><td>2086</td><td>7113.3</td></tr>
<tr><td>Total</td><td>2432.6</td><td>7459.9</td></tr>
<tr><td colspan="5">Notes:
The hourly emissions were calculated assuming 30 days per month and 24 hours per day operation.</td></tr>
</table>

SER Analysis

As noted previously, VOC emissions from this project are above the SER for PSD. Potential emissions for all other PSD pollutants remain unchanged after expansion of the SFG operations and are therefore not subject to PSD review.

4.8. Additional Impact Analysis

PSD regulations [40 CFR 51.166(k)] also require a discussion of additional impacts and evaluation of potential impacts at Class I areas. The additional impact analysis generally has four parts as follows:

- Visibility impairment
- Growth
- Soils impacts, and
- Vegetation impacts.

Class I areas are federally protected areas for which more stringent air quality standards apply to protect unique natural, cultural, recreational, and/or historic values. The nearest Class I area is Swanquarter National Wilderness Area, which is located approximately 68 km southeast of the facility.

4.8.1 Visibility Impairment

Visibility impairment is primarily a function of PM and NOx emissions. Avoca is not subject to PSD review for any pollutants other than VOC, and emissions of PM and NOx are not changing as a result of the proposed modification. Because there are no significant increases of visibility-affecting pollutants, no analysis of visibility impairment is required for this project.

4.8.2 Growth Analysis

The growth analysis includes the projection of the associated industrial, commercial and residential source emissions that will occur in the area due to modification of the source. The evaluation looked at the local work force increase and assessed secondary emission sources that potentially will build in the area to support the Avoca facility.

Approximately 100 people are currently employed by the Avoca facility. Avoca does not anticipate that the number of employees will increase due to the proposed modification.

Employment for Bertie County was obtained from the NC Department of Commerce. The data indicates an average unemployment rate of 10.5% (1,008 people). If Avoca needs to increase employment due to this modification, workers are expected to come from the existing labor pool. No new support services or suppliers are expected to locate in the area as a result of this project. Thus, the impact of economic growth associated with the proposed project will be negligible.

4.8.3 Soils and Vegetation

The only potential impact on soils and vegetation resulting from the proposed project would be on long term damage associated with the elevated ozone levels. The effects of ozone on vegetation are well documented. Symptoms of ozone damage include reduction in growth rates, reduction in reproductive rates, direct foliar damage, and mortality.

VOCs are regulated because they can be a precursor to ozone formation. In addition to VOCs, an important component of ozone formation is the ambient concentration of NOx. Studies have shown that ozone formation in the southeast is NOx limited, meaning that ozone formation is limited by the amount of NOx in the atmosphere rather than the amount of VOCs. Because this project will increase the amount of VOCs emitted rather than NOx, it is unlikely to significantly impact the amount ozone formed and, consequently, it will not adversely affect vegetation in the surrounding area.

4.8.4 Class I Impact Analysis

PSD Class I impact analyses contain evaluations of Air Quality Related Values (AQRV) and PSD increment were applicable. AQRV are typically defined as visibility (both near-field plume impairment and/or regional haze) and acidic deposition. As previously discussed, there will be no signification increases of any visibility–affecting pollutants as a result of this modification. Thus, no visibility analysis is warranted. There are also no significant increases of any deposition-related pollutants (SO_2 or NO_X) expected as result of this modification. Therefore, no deposition analysis is required. Finally, there are no modeling related standards for VOCs (e.g. NAAQS or PSD increments). Therefore, no Class I or Class II area dispersion modeling analyses are required for this permit modification.

4.9 Public Participation Requirements

In accordance with 40 CFR 51.166(q), Public participation, the reviewing authority (NCDAQ) shall meet the following:

1) Make a preliminary determination whether construction should be approved, approved with conditions, or disapproved.

   This document satisfies this requirement providing a preliminary determination that construction should be approved consistent with the permit conditions described herein.

2) Make available in at least one location in each region in which the proposed source would be constructed a copy of all materials the applicant submitted, a copy of the preliminary determination, and a copy or summary of other materials, if any, considered in making the preliminary determination.

   This preliminary determination, application, and draft permit will be made available in the Washington Regional Office and in the Raleigh Central Office, with the addresses provided below.

Washington Regional Office	Raleigh Central Office
943 Washington Square Mall	217 West Jones Street
Washington, NC 27889	Raleigh, NC 27603

   In addition, the preliminary determination and draft permit will be made available on the NCDAQ public notice webpage.

3) Notify the public, by advertisement in a newspaper of general circulation in each region in which the proposed source would be constructed, of the application, the preliminary determination, the degree of increment consumption that is expected from the source or modification, and of the opportunity for comment at a public hearing as well as written public comment.

   The NCDAQ prepared a public notice (See Appendix A) that will be published in a newspaper of general circulation in the region.

4) Send a copy of the notice of public comment to the applicant, the Administrator and to officials and agencies having cognizance over the location where the proposed construction would occur as follows: Any other State or local air pollution control agencies, the chief executives of the city

and county where the source would be located; any comprehensive regional land use planning agency, and any State, Federal Land Manager, or Indian Governing body whose lands may be affected by emissions from the source or modification.

The NCDAQ will send the public notice (see Appendix A) to the Town Administrator of Windsor at PO Box 508, 106 Dundee Street Windsor, NC 27983 and the Bertie County Manager at PO Box 530, 106 Dundee Street, Windsor, NC 27983.

5) Provide opportunity for a public hearing for interested persons to appear and submit written or oral comments on the air quality impact of the source, alternatives to it, the control technology required, and other appropriate considerations.

The NCDAQ public notice (See Appendix A) provides contact information to allow interested persons to submit comments and/or request a public hearing.

5.0 Other Issues

5.1 Compliance

NCDAQ has reviewed the compliance status of this facility. During the most recent inspection completed during three site visits on December 16, 2014, January 12, 2015, and January 15, 2015, Betsy Huddleston of the Washington Regional Office indicated that the facility appeared to be in compliance with all applicable requirements. Additionally, a signed Title V Compliance Certification (Form E5) indicating that the facility was in compliance with all applicable requirements was included with the permit application, received on September 4, 2015.

The following is the five-year compliance history for the facility.

- A Notice of Violation/Notice of Recommendation for Enforcement (NOV/NRE) was issued on October 31, 2012 for a failed particulate stack test. The biomass boilers had exceeded the particulate matter standard under 40 CFR Part 63, Subpart DDDDD. A civil penalty in the amount of $4,549, including costs, was issued on February 14, 2013. The civil penalty was paid in full on March 22, 2013.
- A Notice of Deficiency (NOD) was issued on March 5, 2014 because the downtime of the oxygen analyzer and steam meter on boilers (ID Nos. ES-BB1 and ES-BB2) exceeded the allowable thresholds.

All NOVs, NOV/NREs, and NODs have been resolved.

5.2 Zoning Requirements

The area in which Avoca is located does not have zoning. As such, a notice was placed in the local paper and a sign has been placed in front of the plant as required pursuant to 15A NCAC 2Q .0113. The facility provided an affidavit and proof of publication of the legal notice as part of the permit application.

5.3 Professional Engineer’s Seal

A Professional Engineer's seal was included with the application. Mr. M. Dale Overcash, a Professional Engineer, who is currently registered in the State of North Carolina, sealed the application for the portions containing the engineering plans, calculations, and all supporting documentation.

5.4 Application Fee

An application fee in the amount of $14,294.00 was received.

5.5 CAA Section 112(r)

The facility is not subject to Section 112(r) of the Clean Air Act requirements because it does not store any of the regulated substances in quantities above the thresholds in 112(r). This permit modification does not affect the 112(r) status of the facility.

6.0 Conclusion

Based on the application submitted and the review of this proposal by the NCDAQ, the NCDAQ is making a preliminary determination that the project can be approved and a revised permit issued. After consideration of all comments a final determination will be made.